

June 26, 1934.

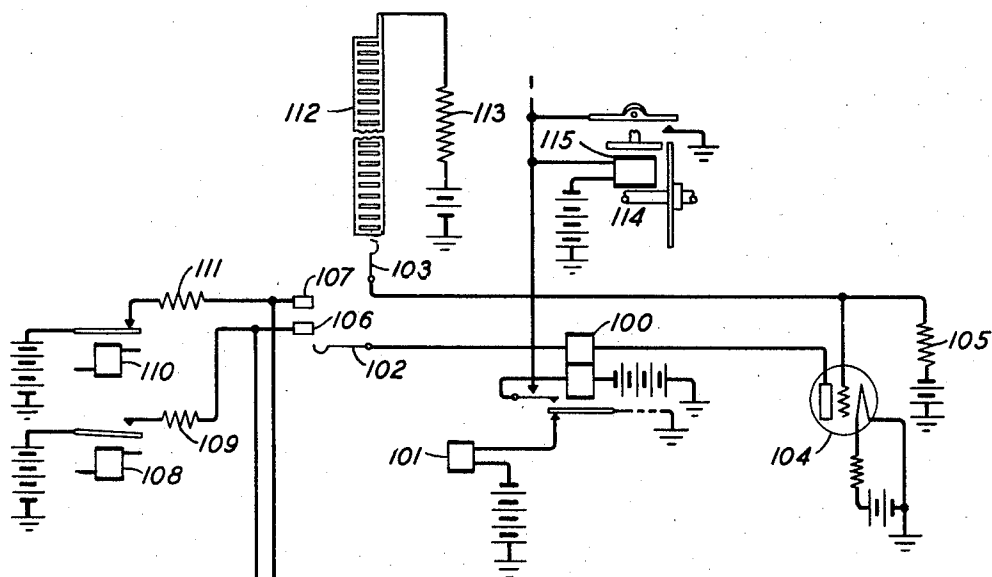
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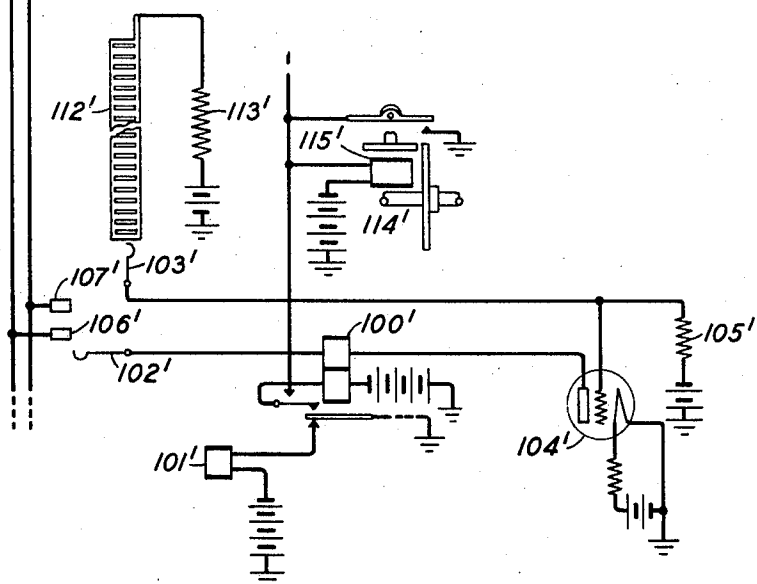
TELEPHONE SYSTEM

Original Filed Nov. 11, 1933

LINK NO. 1



LINK NO. 2



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1,964,588

TELEPHONE SYSTEM

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Application November 11, 1933, Serial No. 697,553

5 Claims. (Cl. 179-16)

The invention relates to telephone exchange systems and more particularly to systems employing automatic switches for establishing desired connections. The invention has principally for its object new and improved circuits for controlling the testing operation of an automatic switch whereby the unguarded interval following the testing and seizure of an idle outgoing trunk or circuit is materially reduced and a simplification of the testing circuit is attained.

In a selector switch which is arranged to hunt for an idle outgoing trunk or circuit from a group of similar trunks or circuits accessible therefrom, provision is made for closing the circuit of the driving magnet of the switch to advance the switch brushes over the terminals of its bank to which trunks are connected, the hunting movement of the brushes being arrested through the operation of a suitable test relay when the test brush encounters the test terminal of an idle trunk. To avoid double connections to an idle trunk which might result if two hunting switches simultaneously tested the same trunk it has heretofore been necessary to employ very sensitive test relays so margined that only one of the switches could be arrested in its hunting movement with its brushes in engagement with the terminals of the idle trunk.

In accordance with the present invention, one embodiment of which has been disclosed for the purposes of illustration, the employment of a double test relay is obviated through the use of a gas-filled tube as a testing device. The gas-filled tube may be of the type having a cathode, a grid or control electrode, and an anode, and filled with an inert gas, such as neon or argon, its cathode being heated either directly from a source of direct current or indirectly by conduction from a heater filament energized by either direct or alternating current. A tube of this type breaks down or flashes when the potential applied to the grid is raised above a critical value.

The anode of the tube is connected in a circuit path extending through the operating winding of a stop relay to the test brush of the switch and the grid is connected through a resistance to the negative pole of a source of energy and to the brush centering commutator of the switch. The stop relay over its back contact controls the circuit of the driving magnet of the switch. Normally the grid is biased below the breakdown potential of the tube. To hunt for an idle trunk the circuit of the driving magnet is closed and as the test brush passes on to the test terminal of an idle trunk which is connected to positive bat-

tery through a resistance, the anode circuit is partially closed. As soon as the switch brushes reach the center of the terminals of the idle trunk the centering commutator brush engages a conducting segment of the commutator thereby connecting positive potential to the grid of the tube through a resistance. The potential on the grid is thereby raised to the breakdown potential of the tube and the tube flashes completing the anode circuit therethrough to operate the stop relay which opens the circuit of the driving magnet, locks and advances the circuit of the switch out of the hunting position. As soon as the tube flashes the flow of current over the test brush reduces the potential on the multiples of the test terminal of the trunk thereby making the trunk busy to other selector switches.

The interval during which the trunk is unguarded after the test brush engages the test terminal thereof is the operating time of the tube plus the time required for the current in its anode circuit to build up to a point which will reduce the potential on the test terminal of the trunk sufficiently to give a non-operate condition for the tube of another selector switch even though the centering commutator thereof is closed.

A clearer understanding of the invention may be obtained from a consideration of the following detailed description read in conjunction with the accompanying drawing which illustrates the application of this invention to a link circuit arranged for sender hunting.

The drawing shows such portions of two identical link circuits and sender circuits, as are involved in the selection of an idle sender by a link circuit. The link circuit may be of the type disclosed in Patent No. 1,690,206 granted November 6, 1928 to A. Raymond.

Referring to the drawing, multiplied sender test terminals 106 and 106' are shown connected to a busy sender, the associated sender relay 108 being operated and having opened the circuit from positive battery, back contact of relay 108, through resistance 109 to the test terminals 106 and 106'. Multiplied sender test terminals 107 and 107' are shown connected to an idle sender, the associated sender relay 110 being unoperated. Positive battery is therefore connected over the back contact of relay 110, through resistance 111 to test terminals 107 and 107'.

The grids of gas filled tubes 104 and 104' are connected to negative battery through resistances 105 and 105' respectively, and to the centering commutator brushes 103 and 103' respectively. The anodes of tubes 104 and 104' are connected

through the upper windings of their respective stop relays 100 and 100' to the associated test brushes 102 and 102'. The cathodes of tubes 104 and 104' may be heated either directly from a source of direct current or indirectly by means of a heater element energized from direct or alternating current, direct current heating being shown. Tubes 104 and 104' are of the type which break down and become conducting when their grid potential is raised above a critical value.

The centering commutators 112 and 112' are connected to positive battery through the associated respective resistances 113 and 113'.

Assuming that sequence switch 114 of link No. 1 has been advanced into the hunting position, ground is connected by the link circuit, in the usual manner, over the back contact of stop relay 100, to battery through the winding of the up-drive magnet 101. Magnet 101 energized, causes the brush shaft (not shown) carrying test brush 102 and centering brush 103 to move upward to hunt for an idle sender.

The advancing test brush 102 first comes into contact with test terminal 106. Since the sender to which terminal 106 is connected is busy, its associated relay 108 being operated, brush 102 encounters no positive battery on terminal 106.

When the advancing test brush 102 and its associated brushes (not shown) are fully centered on the sender terminals, centering brush 103 contacts the conducting segment of centering commutator 112 which corresponds to the particular sender terminals on which the brushes are centered. Positive battery through resistance 113, over the segment of commutator 112, is connected over brush 103 to the grid of tube 104, in parallel with negative battery through resistance 105, thereby raising the potential on the grid of the tube to the breakdown value. Since there is no positive potential connected to the anode of tube 104 from test terminal 106, the tube does not break down and stop relay 100 does not operate. The brush shaft, therefore, continues to advance brushes 102 and 103, in search of an idle sender.

When test brush 102 contacts test terminal 107, which is connected to an idle sender, positive battery is connected to the anode of tube 104, over the back contact of the associated unoperated sender relay 110, resistance 111, test terminal 107, test brush 102 and the upper winding of stop relay 100.

When test brush 102 and its associated brushes (not shown) are fully centered on test terminal 107 and its associated sender terminals, centering brush 103 engages a corresponding conducting segment of centering commutator 112. Positive battery, through resistance 113 and commutator 112, is connected over brush 103 to the grid of tube 104, in parallel with the negative battery through resistance 105, thereby raising the grid potential of tube 104 to the breakdown point. Tube 104 breaks down and becomes conducting, operating stop relay 100 from positive battery over the back contact of relay 110, resistance 111, test terminal 107, brush 102, upper winding of relay 100, to negative battery over the anode and cathode of tube 104. Stop relay 100, by its operation, opens the circuit from ground over its back contact, through the winding of up-drive magnet 101 to battery, causing magnet 101 to de-energize and arrest the advance of the brush shaft and brushes. Relay 100 operating, also locks from battery through its lower winding, to ground over its lower front contact, and connects ground over its upper front contact to bat-

tery through the winding of sequence switch magnet 115. Magnet 115 energizes and causes sequence switch 114 to advance out of the hunting position.

Immediately upon the breakdown of tube 104, as hereinbefore described, the flow of current from positive battery over the back contact of relay 110, resistance 111, test terminal 107, test brush 102, through the upper winding of relay 100 and the anode and cathode of tube 104 to negative battery, reduces the potential on test terminal 107 and any multiple thereof. This reduction in potential constitutes a busy condition, since the remaining potential is insufficient to cause the breakdown of the gas filled tube of any other hunting link circuit should the anode circuit of that tube be connected to a multiple of test terminal 107 at this time. In this manner, the link circuit first to reach and select an idle sender, immediately places a busy condition on the test terminals associated with that sender.

As a further illustration, assume that sequence switches 114 and 114' of link circuits No. 1 and No. 2 respectively, are advanced to their hunting positions at about the same time, and that both links start hunting for idle senders. Assume further that link No. 1, functioning as hereinbefore described in detail, is the first to reach and select the sender associated with test terminal 107, and that the breakdown of tube 104 lowers the potential on terminal 107, and any multiple terminal thereof, due to the flow of current through the anode circuit of tube 104.

Link circuit No. 2, identical with link circuit No. 1, in hunting an idle sender, hunts past the busy sender terminals associated with test terminal 106' in the same manner as that hereinbefore set forth for link No. 1.

When the brushes of link No. 2 have been advanced and are centered on test terminal 107' and its associated sender terminals (not shown), centering brush 103' engages a corresponding conducting segment of centering commutator 112'. Positive battery through resistance 113' is connected over commutator 112' and brush 103' to the grid of tube 104', in parallel with negative battery through resistance 105'. The reduced potential on test terminal 107', over brush 102' through the upper winding of stop relay 100', to the anode of tube 104', is insufficient to cause tube 104' to break down and complete its anode circuit. Stop relay 100' therefore does not operate and the brush shaft of link No. 2 continues to advance brush 102' upward in search of another idle sender.

The use of a gas filled tube as a testing device, in place of the previously used sensitive marginal test relay, materially reduces the unguarded interval during which two link circuits can connect to the terminals of the same sender since this interval consists only of the time required for the tube to break down plus the build-up time of its anode current to a point where the test terminal potential is reduced to a value below that required to break down the tube of another link circuit, even though the centering commutator circuit to the grid of that tube is closed.

While the drawing and the foregoing description thereof cover only the typical application of the invention to link circuits which are arranged for sender hunting, it is obvious that the invention is equally applicable to any automatic selector switch arranged for hunting an idle line or trunk, which lines or trunks are accessible to other selector switches.

What is claimed is:

1. A test circuit for an automatic switch comprising a stop relay and a gas-filled tube, the anode circuit of said tube including the test brush of said switch and the operating winding of said relay and the grid of said tube being normally biased below the breakdown potential of said tube, and means operative when said test brush is centered on an idle test terminal to raise the potential on said grid to such an extent as to cause said tube to break down and operate said stop relay to arrest the hunting movement of said switch.

2. A test circuit for an automatic switch comprising a stop relay, a brush centering commutator and a gas-filled tube, the anode circuit of said tube including the test brush of said switch and the operating winding of said relay and the grid of said tube being normally biased below the breakdown potential of said tube, and circuit means controlled by said centering commutator operative when said test brush is centered on an idle test terminal to raise the potential on said grid to such an extent as to cause said tube to break down and operate said stop relay to arrest the hunting movement of said switch.

3. A test circuit for an automatic switch comprising a stop relay and a gas-filled tube, the anode circuit of said tube including the test brush of said switch and the operating winding of said relay and the grid of said tube being normally biased below the breakdown potential of said tube, means for applying positive potential to said anode circuit when the test brush encounters an idle test terminal, and means operative when said test brush is centered on an idle test terminal to raise the potential on said grid to such an extent as to cause said tube to break down and complete said anode circuit thereby operating said stop relay to arrest the hunting movement of said switch.

4. A test circuit for an automatic switch comprising a stop relay, a brush centering commutator and a gas-filled tube, the anode circuit of said tube including the test brush of said switch and the operating winding of said relay, and the grid of said tube being normally biased below the breakdown potential of said tube, means for applying positive potential to said anode circuit when the test brush encounters an idle test terminal, and circuit means controlled by said centering commutator operative when said test brush is centered on an idle test terminal to raise the potential on said grid to such an extent as to cause said tube to break down and operate said stop relay to arrest the hunting movement of said switch.

5. A test circuit for an automatic switch comprising a stop relay, a brush centering commutator and a gas-filled tube, the anode circuit of said tube including the test brush of said switch and the operating winding of said relay the grid of said tube being normally biased below the breakdown potential of said tube, means for applying positive potential to said anode circuit when said test brush encounters an idle test terminal, circuit means controlled by said centering commutator when said test brush is centered on said test terminal to raise the potential on the grid of said tube to such an extent as to cause said tube to break down to operate said stop relay to arrest the hunting movement of said switch, and to reduce the positive potential on said test terminal to such an extent as to prevent the breakdown of the tube of the test circuit of a second simultaneously hunting automatic switch, the test brush of which second switch encounters a multiple of said test terminal at that time.

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